Enterococcus on U.S. Beef Cow-calf Operations, 2007–08

Most enterococcal bacteria are normal inhabitants of human and animal gastrointestinal tracts. However, enterococci are also a common cause of hospital-acquired infections in humans, especially after surgery. Two species of enterococci, *Enterococcus faecalis* and *E. faecium*, are responsible for most human disease caused by enterococci, with *E. faecalis* predominantly responsible for most infections. However, antimicrobial resistance is more common with *E. faecium* than with *E. faecalis*.

Antimicrobial resistant enterococci can be found in livestock, and there are concerns that the resistance components of these enterococci could be transferred to other bacteria, including those that cause human illness. It is possible that foodborne transmission of enterococci could also play a role in human illness. However, the extent of any contribution to human illness from enterococci of livestock origin is not well understood.

Beef 2007–08 study

The U.S. Department of Agriculture's National Animal Health Monitoring System conducted the Beef 2007–08 study, which focused on beef cow-calf health and management practices in 24 States.* These States represented 79.6 percent of U.S. operations with beef cows and 87.8 percent of U.S. beef cows.

One objective of the Beef 2007–08 study was to describe the occurrence of *Enterococcus* and associated antimicrobial resistance on beef cow-calf operations in the United States.

Testing for *Enterococcus* was performed on 173 of the beef cow-calf operations participating in the study. Up to 10 fresh fecal samples from individual fecal pats on the ground were taken from each operation and tested for presence of *Enterococcus*. Care was taken to ensure that samples originated from adult beef cows. Of the 1,479 samples collected, 1,182 (79.9 percent) were positive for *Enterococcus*, and at least one positive sample was found on 170 of the 173 operations (98.3 percent).

E. faecalis and/or *E. faecium* were found on 43.9 percent of operations. Of the 1,182 positive samples, 11.5 percent and 3.2 percent were *E. faecium* and *E. faecalis*, respectively (table 1). The highest percentage of isolates (39.0 percent) were identified as *E. casseliflavus*. Of the operations on which enterococci were found, 83.5 percent had at least one *E. casseliflavus* isolate and 73.5 percent had at least one *E. hirae* isolate. *E. faecium* and *E. faecalis* were found on 38.8 percent and 14.1 percent of positive operations, respectively.

Table 1. Number and Percentage of Isolates (and Number and Percentage of Positive Operations), by *Enterococcus* Species

	Isolates* (n=1,182)		Operations (n=170)	
Species	**No.**	**Pct.**	**No.**	**Pct.**
E. casseliflavus	461	39.0	142	83.5
E. hirae	303	25.6	125	73.5
E. mundtii	169	14.3	73	42.9
E. faecium	136	11.5	66	38.8
Not typed	57	4.8	43	25.3
E. faecalis	38	3.2	24	14.1
E. gallinarum	9	0.8	6	3.5
E. durans	6	0.5	5	2.9
E. avium	3	0.3	3	1.8
Total	1,182	100.0	NA	NA

*The number of isolates equals the number of positive samples since only one *Enterococcus* species was identified in each sample.

Enterococcus antimicrobial susceptibility

Of the 1,180 isolates tested for antimicrobial susceptibility, 11 (0.9 percent) were susceptible to all 17 antimicrobials. Two isolates were not viable at the time of antimicrobial testing. All of the *E. faecalis* and *E. faecium* isolates were resistant to at least one antimicrobial. Vancomycin resistance is of particular interest, since it is commonly used to treat humans with serious enterococcal infections.[1] One *E. casseliflavus* isolate was resistant to vancomycin, but this was determined to be an intrinsic resistance (naturally occurring trait) rather than an acquired resistance. None of the *E. faecalis* or *E. faecium* isolates was resistant to vancomycin. Resistance to quinupristin/dalfopristin (Synercid®) is also of importance because this

*States:
Alabama, Arkansas, California, Colorado, Florida, Georgia, Idaho, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota Tennessee, Texas, Virginia, and Wyoming.

antimicrobial is used to treat vancomycin-resistant *E. faecium* infections.[1] Only 0.7 percent of *E. faecium* and 0.9 percent of other enterococci were resistant to Synercid. Over 90 percent of the *E. faecium* and other enterococci were resistant to flavomycin, while none of the *E. faecalis* isolates were resistant to flavomycin. Overall, 100.0, 54.1, and 90.7 percent of the *E. faecalis*, *E. faecium*, and other enterococci, respectively, were resistant to lincomycin (table 2).

Table 2. Percentage of Resistant *Enterococcus* Isolates, by Species and by Antimicrobial:*

	Percent		
	E. faecalis (n=38)	***E. faecium*** (n=135)	**Other Enterococci** (n=1,007)
Antimicrobial	**Percent**	**Percent**	**Percent**
Chloramphenicol	0.0	0.7	0.0
Ciprofloxacin	0.0	45.9	4.1
Daptomycin**	0.0	0.0	5.3
Erythromycin	0.0	0.7	0.8
Flavomycin	0.0	92.6	90.3
Gentamicin	0.0	0.0	0.0
Kanamycin	0.0	1.5	0.0
Lincomycin	100.0	54.1	90.7
Linezolid	0.0	0.0	0.0
Nitrofurantoin	0.0	3.0	0.1
Penicillin	2.6	0.7	0.4
Streptomycin	0.0	0.0	0.0
Synercid	NA***	0.7	0.9
Tetracycline	2.6	12.6	18.2
Tigecycline**	0.0	0.0	0.0
Tylosin	0.0	0.0	1.1
Vancomycin	0.0	0.0	0.1****

*Intermediate isolates were classified as susceptible.
**The Clinical and Laboratory Standards Institute has no approved standards for daptomycin and tigecycline susceptibility testing.
****E. faecalis* exhibits an intrinsic resistance to synercid.
*****One *E. casseliflavus* isolate was intrinsically resistant to vancomycin.

Conclusions

Enterococcus was found on 98.3 percent of the beef cow-calf operations tested and in 79.9 percent of the samples collected. The high prevalence of enterococci was expected, since this organism is a normal inhabitant of the gastrointestinal tract of animals and humans. *E. faecalis* or *E. faecium*, the organisms responsible for most of the human illness caused by enterococci, were found on less than one-half of operations (43.9 percent). *E. casseliflavus* was the most common species identified. Synercid and vancomycin are two of the more important antimicrobials used in treating human enterococcal infections. There was very little resistance to synercid and no notable resistance to vancomycin. Resistance to lincomycin and flavomycin was most commonly observed in the isolates from this study.

References

1. McGowan, LL, Jackson, CR, Barrett, JB, Hiott, LM, Fedorka-Cray, PJ. 2006. Prevalence and antimicrobial resistance of *Enterococci* isolated from retail fruits, vegetables, and meats. *J. Food Prot.* 69:12;2976-2982.

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